

इंटरनेट

मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”

Mazdoor Kisan Shakti Sangathan

“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS 13360-9-9 (2001): Plastics - Methods of Testing, Part 9: Optical Properties, Section 9: Determination of Yellow Index of Plastics [PCD 12: Plastics]



“ज्ञान से एक नये भारत का निर्माण”

Satyanarayan Gangaram Pitroda

“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

BLANK PAGE



भारतीय मानक

प्लास्टिक — परीक्षण पद्धतियाँ

भाग 9 प्रकाशिक गुणधर्म

अनुभाग 9 प्लास्टिक पीत सूचकांक को ज्ञात करना

Indian Standard

PLASTICS — METHODS OF TESTING

PART 9 OPTICAL PROPERTIES

Section 9 Determination of Yellow Index of Plastics

ICS 83.080.01

© BIS 2001

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

February 2001

Price Group 2

FOREWORD

This Indian Standard (Part 9/Sec 9) was adopted by the Bureau of Indian Standards, after the draft finalized by the Methods of Test for Plastics Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

Yellowness index obtained by the method prescribed in this standard correlates reasonably well with the magnitude of yellowness perceived under day-light illumination.

Yellowness index of transparent and translucent plastics is a function of thickness. Comparison should be made only between specimens of comparable thickness.

For control work, tristimulus colorimeters are useful so long as their inaccuracies and differences from this primary test method are known.

This test method achieves its greatest accuracy in the determination of differences in yellowness index of sample versus a control of similar material and colorant composition. Change of yellowness index determined by this test method has proved useful in evaluation of degradation of plastics under exposure to heat, light, or other environment.

The guidance regarding derivation of equations for calculation of yellowness index from photoelectric tristimulus colorimeter measurements is given in Annex A.

While preparing this standard considerable assistance has been derived from ASTM D 1925-70 (Reapproved 1988) 'Standard test method for yellowness index of plastics' issued by American Society for Testing and Materials (ASTM), USA.

In reporting the results of a test or analysis in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2:1960 'Rules for rounding off numerical values (*revised*)'.

Indian Standard

PLASTICS — METHODS OF TESTING

PART 9 OPTICAL PROPERTIES

Section 9 Determination of Yellow Index of Plastics

1 SCOPE

1.1 This standard (Part 9/Sec 9) prescribes the method for determining the degree of yellowness (or change of degree of yellowness) under day-light illumination of homogeneous, non-fluorescent, nearly colourless transparent or nearly white translucent or opaque plastics. It is applicable to transmittance of transparent and translucent plastics and to reflectance of opaque plastics. It is based upon tristimulus values calculated from data obtained on the Hardy-G.E. type spectrophotometer, but other apparatus is satisfactory if equivalent results are obtained.

1.2 This test method has not been demonstrated for the determination of transmitted yellowness of plastics having a luminous transmittance below 25 percent, and it has not been demonstrated for the determination of reflected yellowness of translucent plastics.

2 TERMINOLOGY

For the purpose of this standard the following definitions shall apply.

2.1 Yellowness — Deviation in chroma from whiteness or water-whiteness in the dominant wavelength range from 570 to 580 nm.

NOTE — A definition of a method of obtaining dominant wavelength may be found in the literature.

2.2 Yellowness Index (YI) — The magnitude of yellowness relative to magnesium oxide for CIE source C. Yellowness index is expressed as follows:

$$YI = \frac{[100(1.28 X_{CIE} - 1.06 Z_{CIE})]}{Y_{CIE}}$$

where

X_{CIE} , Y_{CIE} and Z_{CIE} = Tristimulus values (see Note) of the specimen relative to source C.

NOTE — By this test method, positive (+) yellowness index describes the presence and magnitude of yellowness; a specimen with a negative (–) yellowness index will appear bluish.

2.3 Change in Yellowness Index (ΔYI) — The difference between an initial value, YI_0 , and YI determined after a prescribed treatment of the plastic.

$$\Delta YI = YI - YI_0$$

NOTE — By this calculation, positive ΔYI indicates increased yellowness and negative ΔYI indicates decreased yellowness or increased blueness.

3 APPARATUS

3.1 Spectrophotometer

4 REFERENCE STANDARDS

4.1 Primary Standard

The primary standard for reflectance measurement is a layer of freshly prepared magnesium oxide. The primary standard for transmittance measurement is air.

4.2 Instrument Standard

Because of the difficulty of preparing a primary reflectance standard, magnesium carbonate, barium sulphate, or calibrated pieces of white structural glass known as vitrolite may be used as instrument standard.

5 TEST SPECIMEN

Opaque specimens shall have at least one plane surface; transparent specimens shall have two surfaces that are essentially plane and parallel. Specimens not having plane surfaces may be compared on a relative basis if of the same shape and if similarly positioned for measurement.

6 CONDITIONING

6.1 Condition the test specimens at $27 \pm 2^\circ\text{C}$ and 65 ± 5 percent relative humidity for not less than 40 h prior to test. In cases of disagreement, the tolerance shall be $\pm 1^\circ\text{C}$ and ± 3 percent relative humidity.

6.2 Test Conditions

Conduct tests in the standard laboratory atmosphere of $27 \pm 2^\circ\text{C}$ and 65 ± 5 percent relative humidity, unless otherwise specified in the material specification.

7 PROCEDURE

7.1 Calibrate and operate the spectrophotometer and other instruments in accordance with instructions supplied by the manufacturer.

7.2 Obtain spectral transmittance data relative to air. For measurement of transmittance of translucent specimens, place freshly prepared matched magnesium oxide standards at the specimen and reference ports at the rear of the sphere. The interior of the sphere shall be freshly coated with magnesium oxide and in good conditions.

NOTES

1 Magnesium oxide standards may be considered matched if on interchanging them the percent reflectance is altered by no more than 1 percent at any wavelength between 400 and 700 nm.

2 The energy transmitted by plastic specimens varies widely in angular distribution about the normal to the surface, depending upon the ability of the specimens to diffuse the incident light. Thus the amount of energy that strikes the surface at the specimen port may vary from nearly 100 percent of the energy transmitted to a percentage determined by the relative areas of specimen port and sphere wall. Furthermore, the diffuse energy has a spectral composition such that the portion striking the surface at the specimen port is yellower than that which is more widely diffused.

3 Matched magnesium carbonate blocks or matched vitrolite tiles are not recommended in the measurement of translucent samples. Matched barium sulphate blocks with freshly scraped surfaces have been demonstrated to give results comparable to magnesium oxide, within the accuracy of this test method.

7.3 Obtain spectral directional reflectance relative to magnesium oxide. Exclude the specular component in reflectance measurement. Back the test specimens with a white standard to obtain spectral directional reflectance.

8 CALCULATION

8.1 Calculate the tristimulus values for source C by numerical integration from recorded spectral data or by automatic integration during the spectrophotometer operation.

8.2 Calculate the magnitude and sign of the yellowness index from the following equation:

$$YI = \frac{[100(1.28 X_{CIE} - 1.06 Z_{CIE})]}{Y_{CIE}}$$

NOTE — For direct calculation of the yellowness index from filter photometer readings obtained with a tristimulus colorimeter the equations given in Annex A may be used. These equations eliminate the need for calculating the tristimulus values.

8.3 If desired, calculate the magnitude and direction of change in yellowness index from the following equation:

$$\Delta YI = YI - YI_0$$

9 REPORT

The report shall include the following:

- a) Complete identification of the material tested;
- b) Specimen thickness;
- c) Magnitude and direction (sign) of the yellowness index; and
- d) Identification of the instrument used by the manufacturer's model and serial number.

ANNEX A

(Foreword and Clause 8.2)

DERIVATION OF EQUATIONS FOR CALCULATION OF YELLOWNESS INDEX FROM PHOTOELECTRIC TRISTIMULUS COLORIMETER MEASUREMENTS

A-1 By the definition given in para 3 of foreword, yellowness index has been defined as:

$$YI = [100 (1.28 X_{CIE} - 1.06 Z_{CIE})] / Y_{CIE}$$

where

X_{CIE} , Y_{CIE} and Z_{CIE} = Tristimulus values (CIE source C) obtained by integration from spectrophotometric data as described in 8.1

A-2 The equations giving calculated tristimulus values from the filter photometer readings are as follows:

$$X_{CIE} = 0.7832 A_o f_x + 0.197 Z_o f_z$$

$$Y_{CIE} = 1.0000 Y_o f_y$$

$$Z_{CIE} = 1.18103 Z_o f_z$$

where

A_o , Y_o and Z_o = Instrumental filter (amber, green and blue reflectance) values relative to an instrument reference standard, and

f_x , f_y and f_z = Ratios of the reflectances of the instrument reference standard to magnesium oxide for each filter.

A-3 Substituting these expressions for X_{CIE} , Y_{CIE} and Z_{CIE} in the equation for yellowness index (A-1).

$$YI =$$

$$\frac{100[1.28(0.7832 A_o f_x + 0.197 Z_o f_z) - 1.06(1.18103 Z_o f_z)]}{1.0000 Y_o f_y}$$

$$= \frac{100(1.002 A_o f_x + 0.2524 Z_o f_z - 1.2524 Z_o f_z)}{Y_o f_y}$$

$$= 100 (1.002 A_o f_x - 0.999 Z_o f_z) / Y_o f_y$$

A-4 Thus, within the precision of the method, for reflectance measurements,

$$YI = 100 (A_o f_x - Z_o f_z) / Y_o f_y$$

For transmittance measurements ($f_x = f_y = f_z = 1$), this equation reduces to:

$$YI = 100 (A_o - Z_o) / Y_o$$

These equations permit calculation of the yellowness index from tristimulus filter colorimeter readings without the labour of calculating approximate tristimulus values.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 1986* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

This Indian Standard has been developed from Doc : No. PCD 23 (1654).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002
Telephones : 323 01 31, 323 33 75, 323 94 02

Telegrams : Manaksanstha
(Common to all offices)

Regional Offices:

	Telephone
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	{ 323 76 17 323 38 41
Eastern : 1/14 C. I.T. Scheme VII M, V.I.P. Road, Kankurgachi CALCUTTA 700 054	{ 337 84 99, 337 85 61 337 86 26, 337 91 20
Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160 022	{ 60 38 43 60 20 25
Southern : C.I.T. Campus, IV Cross Road, CHENNAI 600 113	{ 235 02 16, 235 04 42 235 15 19, 235 23 15
Western : Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400 093	{ 832 92 95, 832 78 58 832 78 91, 832 78 92
Branches : AHMADABAD•BANGALORE•BHOPAL•BHUBANESHWAR•COIMBATORE•FARIDABAD GHAZIABAD•GUWAHATI•HYDERABAD•JAIPUR•KANPUR•LUCKNOW•NAGPUR• PATNA•PUNE•RAJKOT•THIRUVANANTHAPURAM.	